Subnet Relay - Enhancing Multinational Connectivity

By Canadian Navy Lt. Cmdr. Robert Sibbald, U.S. Navy Lt. Joe Zuliani and Dr. Stephan Lapic

To many members of the multinational naval communications community, SNR means signal-to-noise-ratio. But to a growing number of communicators this acronym has a new definition: Subnet Relay. Subnet Relay is a true masterless, ad-hoc, self-organizing data networking technology with inherent relay capabilities that employs tactical line-of-sight (LOS) bearers to carry Internet Protocol (IP) data between groups of ships within a task group.

As a result of multinational collaboration, SNR has been developed over the past few years, matured through successful demonstrations in sea trials, and is in the process of transitioning to the U.S. Navy fleet.

Coalition communications has been identified by the numbered fleet commanders as their number one command, control, communications, computers and intelligence (C4I) warfighting priority.

For nearly half a century, the AUSCANNZUKUS organization has worked to enhance maritime C4 interoperability between the navies of its member nations — Australia, Canada, New Zealand, United Kingdom and United States — and also with the larger coalition community.

In the late 1990s, as a result of increasing satellite congestion, mounting costs and a desire to improve communications availability, AUSCANNZUKUS articulated a requirement to use LOS bearers to carry IP data traffic ship-to-ship within a coalition task group, much like a tactical intranet at sea.

In 1999, work on what became the SNR system, began in earnest when representatives of the five nations met at the Defense Establishment Research Agency (DERA) facility in Portsmouth, U.K., to consider technical approaches.

Three years later in 2003, a prototype was featured as part of the AUSCANNZUKUS contributions to Joint Warrior Interoperability Demonstration (JWID) '03. Later that same year, SNR saw its first at-sea demonstration in a U.S.-Canada joint trial when a four-ship Canadian task group transited from Victoria, British Columbia, to San Diego, Calif. (See Figure 1.)

The trial proved to be a success, transferring data up to 64 kbps and achieving 24/7 network connectivity for four ships with only three satellite connections.

Previously, a task group would have to "time-share" the connections via a predetermined schedule, with a maximum of three ships being connected to the network at any one time.

National, binational and multinational sea trials continued over the next three years, including experimentation within Trident Warrior 2005 and 2006.

What sets SNR apart from many comparable systems is that it makes use of the existing shipboard radio and cryptographic infrastructure by bringing a new controller to use legacy equipment in new ways.

"Subnet Relay is the warfighter's version of what the dial-up telephone modem does to a phone line," said AUSCANNZUKUS C4 Interoperability Project Officer, Canadian Navy Lt. Cmdr. Rob Sibbald.

"Radio equipment that was originally designed for different types of voice communications can, with minimal investment, now be used for text chat, e-mail, Web browsing and other Internet-type applications."

LOS radio assets, primarily in the very high frequency (VHF) and ultra high frequency (UHF) bands, can be used to give tactical commanders an intra-task group data networking system under their local control — without having to rely on strategic reachback through satellite connections.

In addition, units with strategic satellite network connectivity can provide seamless bridging of the LOS subnet back into the global Wide Area Network (WAN).

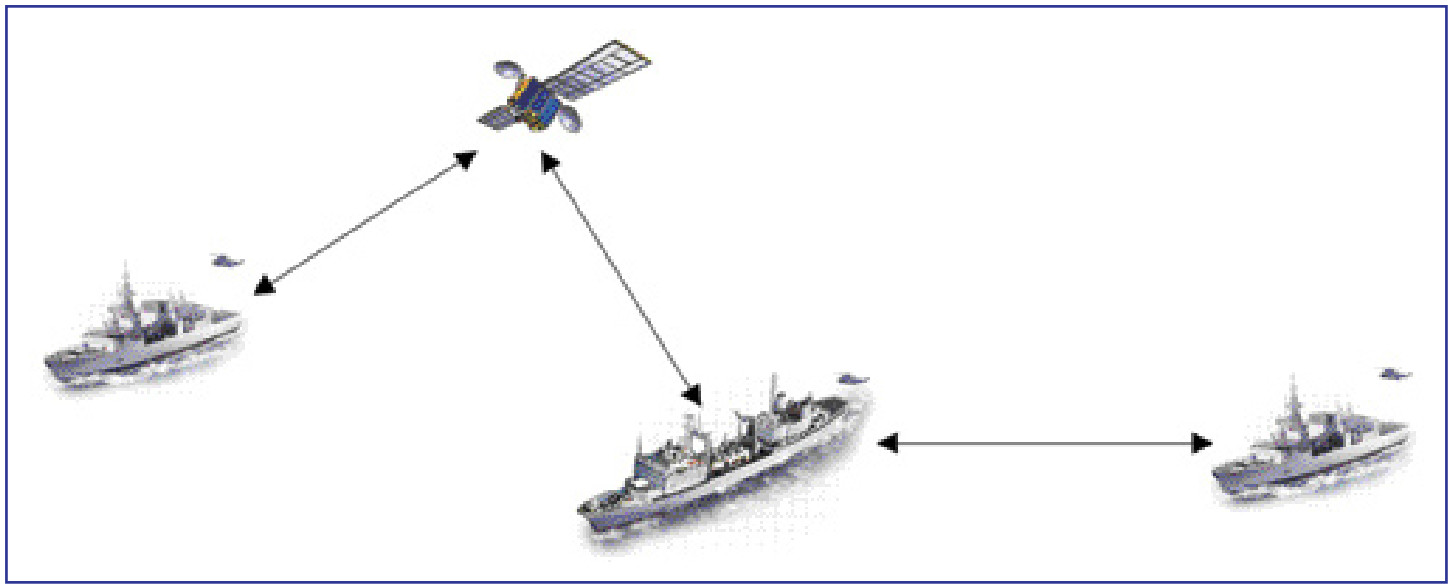

Figure 1. Ships sharing a satellite connection over SNR.

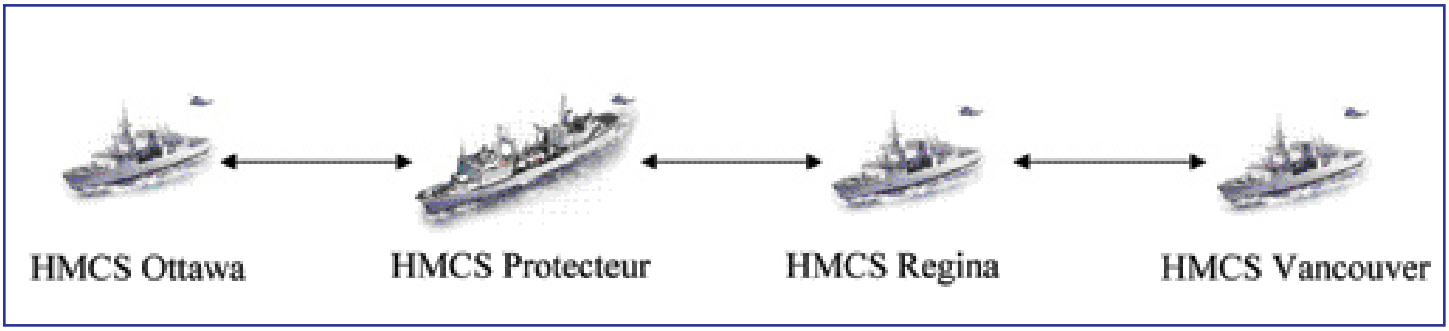

Figure 2. Ships connected in a three-hop SNR configuration.

"Coalition partners, who previously had limited or no shipboard satellite connectivity into tactical networks, such as the Combined Enterprise Regional Information Exchange System (CENTRIXS), can use this technology to increase their connectivity time by sharing another nation's link over SNR," Sibbald said.

This is all done without operator intervention. The system "discovers" other nodes in range, organizes transmissions without a master and relays traffic — automatically.

Sibbald calls this capability "Fire and Forget."

Another key feature of SNR is its ability to automatically relay IP traffic between participating units (or nodes), providing the capability of extending the network between ships that are outside of point-to-point radio range as other ships provide the automatic bridging.

Figure 2 shows IP data being sent from HMCS Ottawa (FFH 341) to HMCS Vancouver (FFH 331) automatically relayed (retransmitted) within the SNR technology through HMCS Protecteur (AOR 509) and HMCS Regina (FFH 334) to Vancouver.

The SNR solution requires two new pieces of equipment to be integrated into the legacy communications system: a self-configuring relay network (SCRN) control node and a high data rate (HDR) modem.

The SCRN control node uses a synchronous time division multiple access (TDMA) protocol to control channel access among multiple platforms, provides relay functionality to support data transfer in multi-hop topologies and provides interfaces to standard shipboard routers and cryptographic gear.

The HDR modem provides advanced coding to increase the data rate with interfaces to standard crypto and shipboard tactical radios. Figure 3 shows how the SNR node and modem fit into a ship's communications architecture.

Rockwell Collins, Inc. (formerly IP Unwired, Inc.) is the AUSCANNZUKUS commercial development partner for SNR. A SNR solution is available for acquisition by coalition members.

The SNR technology solution is in the process of being published as a NATO Standardization Agreement (STANAG) to allow nations to locally manufacture SNR communication products that would be fully interoperable throughout the coalition.

A similar process was used for Battle Force E-mail, an HF point-to-point communication system, published as STANAG 5066.

All AUSCANNZUKUS navies now have capital projects in place to field SNR in the 2007–2010 time frame.

A number of other NATO nations, including France, Germany and the Nether-

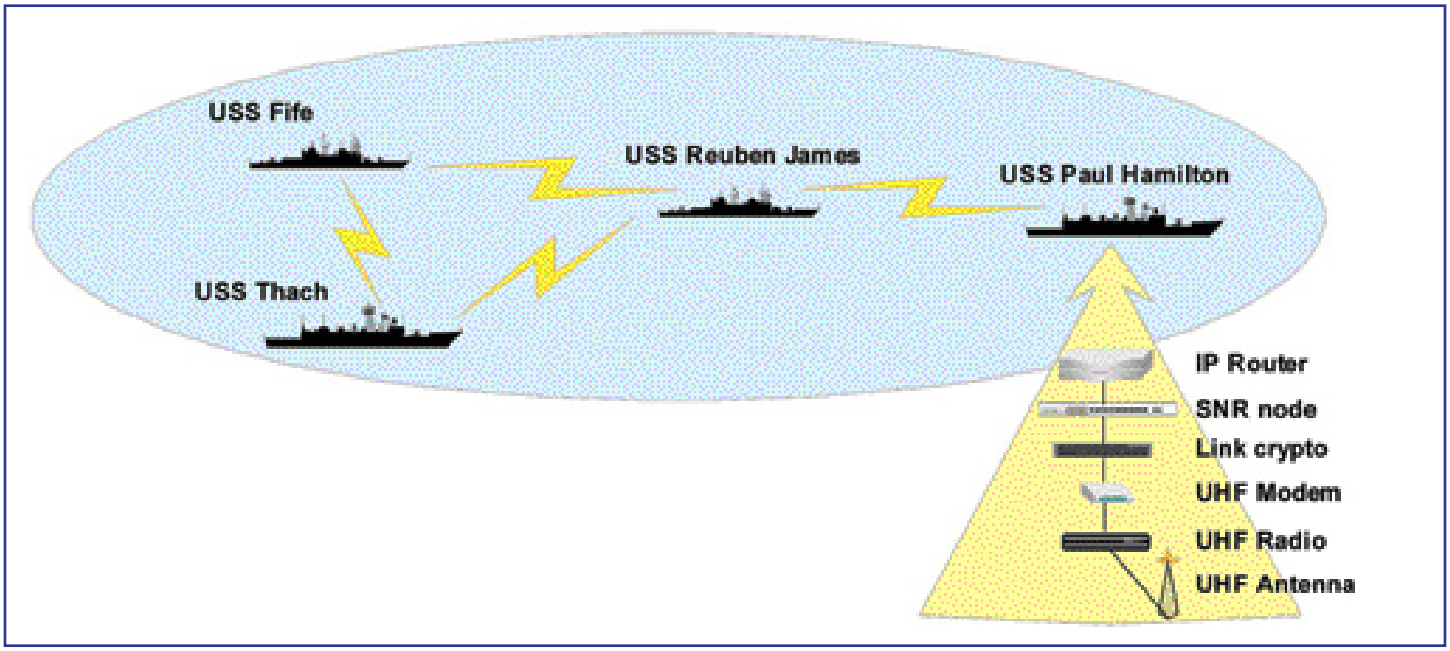

Figure 3. SNR equipment and basic topology.

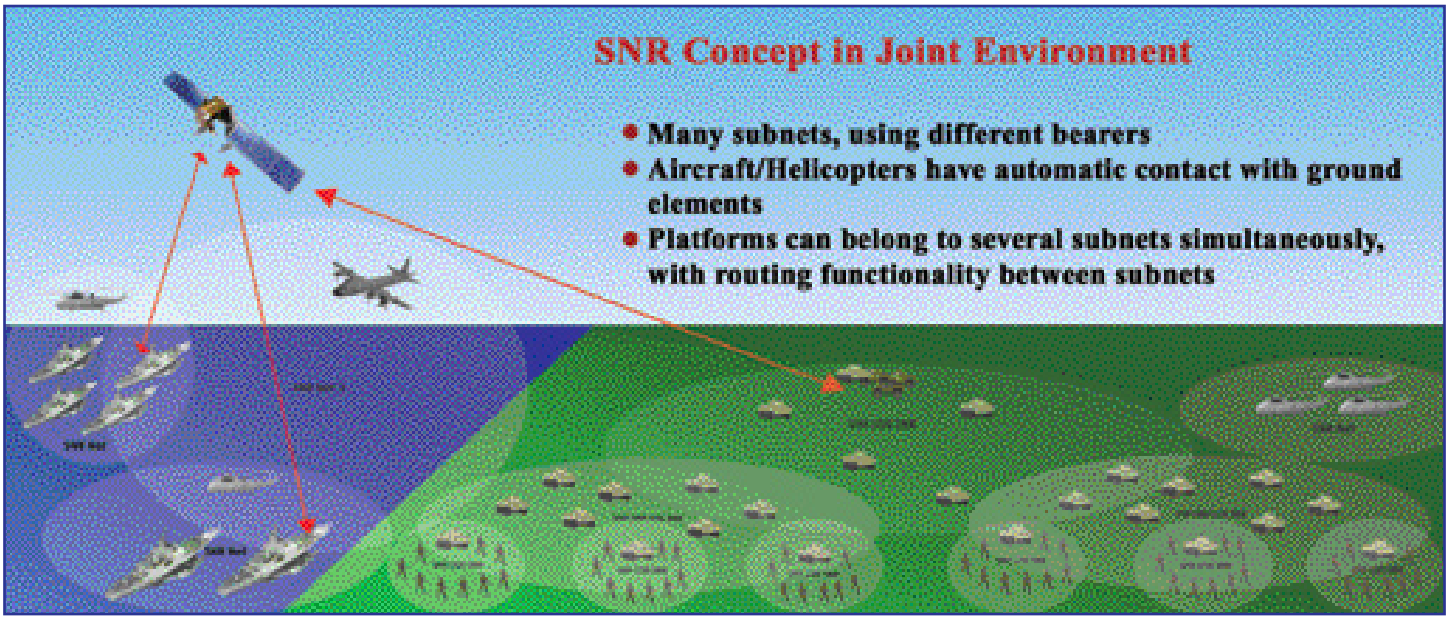

Figure 4. SNR Joint Concept.

SNR Technology Advantages

- Self-organization of participating platforms into networks using line-of-sight (LOS) and extended line-of-sight (ELOS) UHF, VHF and HF bearers.
- Automatic admission of properly configured new members into existing networks.
- Automatic adaptation to topological changes as existing links fail and new links are discovered, including mechanisms for merging multiple SNR networks.
- Traffic relay to extend connectivity to provide beyond line-of-sight (BLOS) connectivity in multi-hop topologies.
- Distributed channel access to support contention-free transmission.
- Adaptive allocation of bandwidth that adjusts transmissions to meet platform requirements.
- A standard interface to a shipboard IP router.
- Interfaces for legacy radios and cryptographic equipment.

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lands, are preparing or conducting at-sea trials of the SNR technology. In addition, NATO is moving to adopt SNR as a requirement for maritime networking.

In preparation for SNR becoming a Navy program of record in fiscal year 2008, SNR will be fielded in March 2007 within the Harry S. Truman (HST) Carrier Strike Group as part of a Rapid Technology Transition operational demonstration.

HST will experiment with the SNR capability during Trident Warrior 2007 and will be able to take advantage of this communications enhancement during her next deployment.

Future efforts will involve increasing efficiency and data throughput in addition to investigating how SNR could be used in the joint environment.

SNR is not a replacement for the next generation of high data rate networking radio systems, such as the Joint Tactical Radio System (JTRS). Rather, Subnet Relay provides a transitional technology; repurposing fitted communications equipment to help support the FORCEnet objectives of today and develop the tactical LOS networking concepts and procedures needed to prepare us for the solutions of tomorrow.

As we move forward through the new millennium, innovative multinational development solutions, such as SNR, will help bring affordable connectivity to the Global Maritime Partnership Initiative; enabling enhanced information sharing and interoperability for all coalition members.

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